

Forest Health Protection

Pacific Southwest Region



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To: District Ranger, Doublehead Ranger District, Modoc National Forest

Subject: Evaluation of mountain pine beetle activity within the Medicine Lake basin (FHP Report NE11-10)

At the request of Modoc National Forest staff including Bill Moore, Monte White and John Landoski, I conducted site visits of the Medicine Lake basin on July 21 and August 8, 2011. The objectives of these visits were to assess the level of mountain pine beetle (*Dendroctonus ponderosae*) caused tree mortality and determine what management options would be most appropriate for the area. Concurrent visits by Forest Health Protection staff (August 1-4) documented the current number of green infested lodgepole pine (*Pinus contorta*) associated with existing mortality pockets throughout the basin.

Site information

Approximately 3,000 acres of lodgepole pine exists within the Medicine Lake basin which lies to the southwest of Lava Beds National Monument (T43N, R3E, Sections 1-3 and 10-14) at elevations ranging between 6,600 and 6,900 feet. Precipitation for the site averages between 30 – 50 inches per year with most areas receiving < 40" per year. The relatively isolated lodgepole pine stands in this area are nearly pure except for scattered red fir (*Abies magnifica*), western white pine (*Pinus monticola*) and mountain hemlock (*Tsuga mertensiana*). The percentages of these other species increase along the edges of the basin.

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Mountain pine beetle activity and associated lodgepole pine mortality

Forest Health Protection staff has visited the Medicine Lake basin several times since mid-July 2011 to assess the level of mountain pine beetle activity within the lodgepole pine forest surrounding the lake. Based on personal observation of tree mortality levels, aerial survey data, aerial imagery, and field recon by FHP staff, it is clear that mountain pine beetle populations are constant to increasing, resulting in high numbers of dead trees both within the campgrounds and administrative areas and throughout the entire basin.

Mountain pine beetle caused tree mortality appears to be greatest in the areas north and east of Schonchin Spring and within and adjacent to campgrounds along the northeast side of Medicine Lake. Analysis of recent aerial imagery, which largely revealed faded lodgepole pines that were attacked in 2009, identified approximately 160 distinct pockets of mortality within the basin ranging from single trees to groups of 20 or more. Eighty-six of these pockets were visited the first week of August to count the number of “green infested” trees (trees attacked in 2010 that have not faded and contain developing bark beetles) which would give some indication of the trend in mountain pine beetle activity. This survey found a total of 410 green infested trees associated with 88% of the previous mortality pockets. When extrapolated out to the entire basin, it is estimated that there are currently over 750 green infested lodgepole pines. This number does not include the likelihood of many more existing pockets of green infested trees that are not associated with previous mortality and thus were not detected with the aerial imagery. Mountain pine beetles currently emerging from these trees will attack many more within the next several weeks, likely equaling or exceeding the 2010 level. It is clear that mountain pine beetles are finding many suitable hosts and are poised to continue causing widespread tree mortality throughout the entire area over the next few years.

Mountain pine beetles tend to attack the larger lodgepole pines within a stand, mostly avoiding trees < 6 - 8 inches diameter breast height (dbh). This trend is occurring within the Medicine Lake basin as 81% of the documented green infested lodgepole pine were >10” dbh. Many more acres of lodgepole pine exist within the basin that contain high numbers of larger diameter (>8” dbh) trees and it is expected that mountain pine beetle caused mortality will continue over the next few years until the majority of these trees are killed. In fact, most lodgepole stands in the Medicine Lake basin appear to be in a high hazard condition in terms of susceptibility to mountain pine beetle epidemics.

Mountain pine beetle caused tree mortality is not new to the Medicine Lake basin as evidenced by the many older snags found throughout the area. A review of aerial detection surveys since 2005 shows elevated tree mortality (~1 tree/acre) each year in the area of Schonchin Spring and Little Medicine Lake with an increase in 2008 (~4 trees/acre). The area of mortality decreased slightly in 2009 and then increased again in 2010 encompassing new areas within the campgrounds and east of the lake (~7 trees/acre in the Schonchin Spring area and ~2 trees/acre in the campgrounds). This ongoing mortality has lead to high numbers of standing dead trees in many locations.

Lodgepole pine dwarf mistletoe (*Arceuthobium americanum*) was also observed in many trees causing bole and limb swellings, brooming and reduced vigor as indicated by thinning crowns.

Treatment Alternatives

Attempting to suppress the current level of mountain pine beetle activity will take a large effort that includes the dedication of funding and time with uncertain results. Effective management options for controlling this expanding outbreak are becoming more limited as bark beetle populations increase. If resources to accomplish suppression efforts are limited then treatments should mostly be centered on protection of small areas and individual trees rather than attempting to control the mountain pine beetle population throughout the entire basin.

Options:

Do nothing: The no management alternative would allow the mountain pine beetle outbreak to continue until most of the suitable host material, i.e. larger diameter lodgepole pines are killed or other environmental factors reduce beetle populations to background levels. In addition, many western white pines growing within and/or adjacent to lodgepole pine stands will also be killed. After suitable host material is depleted, residual stands of scattered red fir, mountain hemlock and smaller diameter lodgepole and western white pine would remain and be at a low risk for future bark beetle caused mortality. However, this alternative would also allow high fuel loads associated with tree mortality to remain on site creating the potential for catastrophic wildfire. This threat would be high while brown needles remain attached to dead pines, be reduced once needles are shed and then increase again as dead trees begin to fall. A fire burning in these types of fuel conditions has the potential to consume residual live conifers, spread to adjacent upslope red fir/western white pine stands and threaten the recreation area and adjacent private land.

Salvage harvest of dead trees (excluding green infested): The removal of older dead trees (no green needles) would reduce much of the fuel loading and capture some of the economic value but would not have any effect on the current beetle population as these trees are no longer suitable host material. Green infested trees would remain on site allowing beetles to emerge the following summer to attack any suitable residuals. This activity will not prevent additional mortality and may require additional salvage operations to meet fuels and/or other management objectives. This treatment could be delayed until mountain pine beetle outbreak has subsided in order to capture the majority of dead trees.

Green infested tree removal: The removal of green infested trees will capture some of the economic value, reduce future fuel loadings and significantly reduce the mountain pine beetle population providing that ALL green infested trees are removed prior to beetle emergence over the entire area (can be combined with the salvage of older dead to capture more economic value and further reduce fuel loads). This would require that harvest activities take place prior to emergence in July/August 2012. If treatments are delayed beyond this date the number of green infested trees may increase dramatically making the effectiveness of this option questionable. All lodgepole stands would then have to be continuously monitored to locate and promptly remove any trees that are attacked after the initial treatment. This could prove to be very difficult due to the large area of lodgepole pine, the lack of access to some areas and the inherent time constraints of the NEPA process. Assuming the current mountain pine beetle outbreak is suppressed by these activities, remaining stands would still be in a high hazard condition due to high stand densities and a large component of larger diameter trees. Fuel loads may still be considered high in some areas depending on residual stocking. This type of treatment could reduce future tree mortality throughout the area but does not guarantee that additional bark beetle activity and subsequent tree mortality will be prevented over the long-term. If the District does not anticipate being able to consistently remove green infested trees over the entire area for the duration of the outbreak then this option will not be effective.

Green tree thinning: Thinning lodgepole pine stands to lower densities and reducing the average stand diameter would normally be effective in reducing the risk of significant mountain pine beetle caused tree mortality, however, since beetle populations are already high, the efficacy of this type of treatment is greatly reduced. In order to maximize the effectiveness of this type of treatment it would have to be implemented beginning in 2012 and combined with green infested tree removal as much as possible. Treatments delayed until 2013 and beyond would likely progress more into salvage operations and less into green tree thinning. This would have negative implications for future funding opportunities as FHP funds are not appropriate for the removal of dead trees.

Thinning in areas of nearly pure lodgepole pine should emphasize species, age, size and spatial diversity to reduce stand hazard. In general, pure lodgepole pine stands should be thinned to SDI levels below 170 (or basal areas at or below 80 sq.ft./acre), combined with a reduction in the average tree diameter, to reduce their susceptibility to bark beetle attacks (Cochran and Dahms 2000). Reducing the number of lodgepole pine > 8" dbh (including trees heavily infected with dwarf mistletoe) within the stands and retaining other species such as red fir where it exists will make thinning treatments even more effective in preventing future bark beetle caused tree mortality. Stands within the campgrounds and other administrative sites should be managed for multiple size/age classes on each acre to ensure continuous forest cover over the long-term. Adjacent areas could have multiple size/age stands as well as even-aged units of various sizes/ages to maximize heterogeneity across the basin.

In addition to increasing the health and vigor of individual trees, thinning can also change the microclimate of the stand, creating a less favorable environment for bark beetle pheromone communication. Opening up the canopy creates convection currents and air turbulence through increases in soil temperature as well as increasing wind speed (Bartos and Amman 1989, Amman and Logan 1998). This prevents bark beetle pheromone plumes from concentrating under the canopy and remaining in close proximity to individual trees or groups of trees.

It should be noted that reducing the basal area in extremely dense larger diameter even-aged stands in one entry can result in wind throw and/or snow breakage of residual trees. This is due to poor growing form and a lack of wind firmness of the residual trees. Therefore, desired stocking levels in these stands may be best achieved through multiple entries over time. This should not be a problem where larger trees have grown under more open conditions or were already in a dominant canopy position.

Thinning to create heterogeneity within the Medicine Lake basin is highly recommended regardless of the timing. In other words, even if thinning occurs after the outbreak subsides; it will still remove heavy fuel loads and put residual lodgepole stands on a trajectory that will reduce the likelihood of future bark beetle mortality.

Just create fuel breaks: To protect the recreation area and adjacent red fir/hemlock/western white pine stands, salvage combined with green tree thinning could be implemented along established roads to create fuel breaks to limit the impacts of wildfire if a fire start occurs in within the area affected by mountain pine beetle caused mortality. These fuel breaks may be strategically placed to gain the maximum effect.

Additional treatment options for the administrative area: To reduce mountain pine beetle caused tree mortality within the administrative area a couple of management options exist; 1) direct control through the removal of green infested lodgepole pine and 2) application of insecticides to un-infested tree boles.

Although there is no general agreement regarding the effectiveness of direct control of mountain pine beetle through green infested tree removal, some success has been observed in Donner Camp, Tahoe National Forest; however, this was a more isolated outbreak in a smaller lodgepole pine stand than the larger stands found in the Medicine Lake area. The effectiveness of this treatment depends on many factors including the mountain pine beetle population level and the size of the host stand. One argument for implementing this type of treatment at the local scale is that mountain pine beetles typically attack individual trees or small groups of trees, reproduce and then emerge to attack adjacent trees. This generally results in an expanding group kill with older dead trees in the middle surrounded by recently dead trees and freshly attacked trees out farthest from the center. Removing green infested trees eliminates the local beetle source in older green infested trees and removes the pheromone source in trees that are currently under attack. To implement this management option, green infested lodgepole pine must be identified and removed promptly. This would require frequent tree inspections during and after the annual flight period and subsequent removal of infested material prior to beetle emergence. Implementing this type of treatment only within the administrative area is not a standalone option at this point and should be combined with one or both of the following treatments.

The second option would be the use of insecticides on tree boles. All non-infested trees greater than 8" DBH that are considered high value within the campgrounds or other administrative areas would be treated with a registered pesticide (either a carbaryl or permethrin product) by spraying the entire bole to the point of saturation. If there are areas where trees less than 8" DBH make up the majority of a stand, the District should also consider spraying a portion of these in the 6 - 8" dbh range. Trees would need to be treated prior to beetle flight in 2012 to be effective. Insecticide treatments can provide protection up to two years against bark beetle attacks so multiple applications may be required to protect trees through the duration of the current mountain pine beetle outbreak. Consideration needs to be given to the choice of insecticide since the campground is in close proximity to the lake.

A third option may exist for lodgepole pine stands that are inaccessible to spray equipment within the recreation area. This would be the use of the anti-aggregation pheromone, verbenone, on an experimental basis. Verbenone pouches can be stapled to trees on a grid throughout the stand or on individual high value lodgepole pines. This type of treatment has shown some success in fending off mountain pine beetle attacks in whitebark pine in the north Warner Mountains on the Fremont National Forest (A. Eglitis, personal communication, 2010). Verbenone is not currently registered in California so an experimental use permit would need to be obtained before any application.

Forest Health Protection can assist with these single-tree protection options and funding may be available on a competitive basis through the western bark beetle program. This evaluation supports the use of FHP funding for all proposed treatments other than salvage.

It is important to note that when implementing individual tree removal or stand thinning in a recreation area, it is required that all conifer stumps greater than 3" in diameter be treated with a registered borate compound (FSM R5 Supplement 2300-92-1 modified by FSH R5 Supplement

3409.11-2010-1) to reduce the probability of infection by *Heterobasidion occidentale* and *H. irregulare*, the causal agents of heterobasidion root disease (formerly referred to as annosus root disease).

If you have any questions regarding this report and/or need additional information please contact me at 530-252-6431 or dcluck@fs.fed.us.

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Mountain pine beetle information

The mountain pine beetle, *Dendroctonus ponderosae*, attacks the bole of ponderosa, lodgepole, sugar and western white pines larger than about 8 inches dbh. Extensive infestations have occurred in mature lodgepole pine forests. Group killing often occurs in mature forests and young overstocked stands of ponderosa, sugar and western white pines.

Evidence of Attack

The first sign of beetle-caused mortality is generally discolored foliage. The mountain pine beetle begins attacking most pine species on the lower 15 feet of the bole. Examination of infested trees usually reveals the presence of pitch tubes. Pitch tubes on successfully infested trees are pink to dark red masses of resin mixed with boring dust. Creamy, white pitch tubes indicate that the tree was able to "pitch out" the beetle and the attack was not successful. In addition to pitch tubes, successfully infested trees will have dry boring dust in the bark crevices and around the base of the tree. Attacking beetles carry the spores of blue-staining fungi which develop and spread throughout the sapwood interrupting the flow of water to the crown. The fungi also reduces the flow of pitch in the tree, thus aiding the beetles in overcoming the tree. The combined action of both beetles and fungi causes the needles to discolor and the tree to die.

Life Stages and Development

The beetle develops through four stages: egg, larva, pupa and adult. The life cycle of the mountain pine beetle varies considerably over its range. One generation per year is typical, with attacks occurring from late June through August. Two generations per year may develop in low elevation sugar pine. Females making their first attacks release aggregating pheromones. These pheromones attract males and other females until a mass attack overcomes the tree. The adults bore long, vertical, egg galleries and lay eggs in niches along the sides of the gallery. The larvae feed in mines perpendicular to the main gallery and construct small pupal cells at the end of these mines where they pupate and transform into adults.

Conditions Affecting Outbreaks

The food supply regulates populations of the beetle. In lodgepole pine, it appears that the beetles select larger trees with thick phloem, however the relationship between beetle populations and phloem thickness in other hosts has not been established. A copious pitch flow from the pines can prevent successful attack. The number of beetles, the characteristics of the tree, and the weather affect the tree's ability to produce enough resin to resist attack. Other factors affecting the abundance of the mountain pine beetle include nematodes, woodpeckers, and predaceous and parasitic insects. As stand susceptibility to the beetle increases because of age, overstocking, diseases or drought, the effectiveness of natural control decreases and pine mortality increases.